being taken into account in forming the equations of motion, and its intensity supposed such as to counteract that part of the total angular velocity of the axis which is perpendicular to the given plane. The equation which determines the motion of the axis is shown to be identical with that of a circular pendulum, and the motion consequently one of oscillation, the mean position of the axis being that in which it approaches, as close as the conditions of the question permit, to the line drawn through its centre of gravity parallel to the earth's axis, and in which it rotates in a direction similar to that of the earth's rotation. Similar reasoning establishes the second part of the theorem, which is theoretically true whether the gyroscope be set rotating or not. This result is, however, in practice modified by the effects of friction; but when a rapid rotatory motion has been impressed on the gyroscope, it acquires a stability which enables it to overcome to a great extent these effects.

December 13, 1860.

Major-General SABINE, R.A., Treasurer and Vice-President, in the Chair.

The Right Hon. the Earl of Sheffield, and the Right Hon. Spencer Horatio Walpole were admitted into the Society.

The following communications were read:—

I. "On an Extension of Arbogast's Method of Derivations." By ARTHUR CAYLEY, Esq., F.R.S. Received October 18, 1860.

(Abstract.)

Arbogast's Method of Derivations was devised by him with a view to the development of a function $\phi(a+bx+cx^2+\ldots)$, but it is at least as useful for the formation of only the literal parts of the coefficients, or, what is the same thing, the combinations of a given degree and weight in the letters $(a, b, c, d, \ldots)$, the weights of the successive letters being 0, 1, 2, 3, &c. Thus instead of applying the method to finding the coefficients

$$a^4,\ 4a^3b,\ 4a^3c+6a^2b^2,\ \&c.,$$

we may apply it merely to finding the sets of terms

$$a^4,\ a^3b,\ a^3c,\ \&c.$$
$$a^2b^2.$$

Nothing can be more convenient than the process when the entire series of columns is required; but it is very desirable to have a process for the formation of any column apart from the others; and the object of the memoir is to investigate a rule for the purpose. It is found that there is, in fact, a rule analogous in some measure to Arbogast's, but which consists in operating simultaneously upon certain pairs of letters: the pairs which may be operated on are four in number, but the conditions are such, that, as regards two of these pairs, when the one is operated on, the other is not, and for the same term the number of pairs operated on is therefore three at most.

II. "On the Method of Symmetric Products, and on Certain Circular Functions connected with that Method." By the Rev. Robert Harley, F.R.A.S., Corresponding Member of the Literary and Philosophical Society of Manchester. Communicated by Arthur Cayley, Esq. Received Oct. 18, 1860.

(Abstract.)

After briefly adverting to his own and to Mr. Cockle's earlier researches on the subject, the author proceeds in the first section of his paper to give a concise systematic exposition of the method of symmetric products, and to indicate a new application of the method to the solution of the lower equations. Hitherto, in applying the theory to the solution of cubics and quartics, an auxiliary equation has been introduced, the symmetric product of which equation has been made to vanish. The peculiarity of the process here employed, is that the auxiliary equation is dispensed with, and the symmetric product remains finite.

In the second section the author deals with circular functions. The structure of such functions is considered, and a calculus devised by means of which operations upon them may be materially abridged. The new cyclical symbol (Σ') is defined; some of its applications are